July 19, 1932. O. J. KUENHOLD 1,867,849

REGULATOR FOR GAS HEATED STEAM RADIATORS

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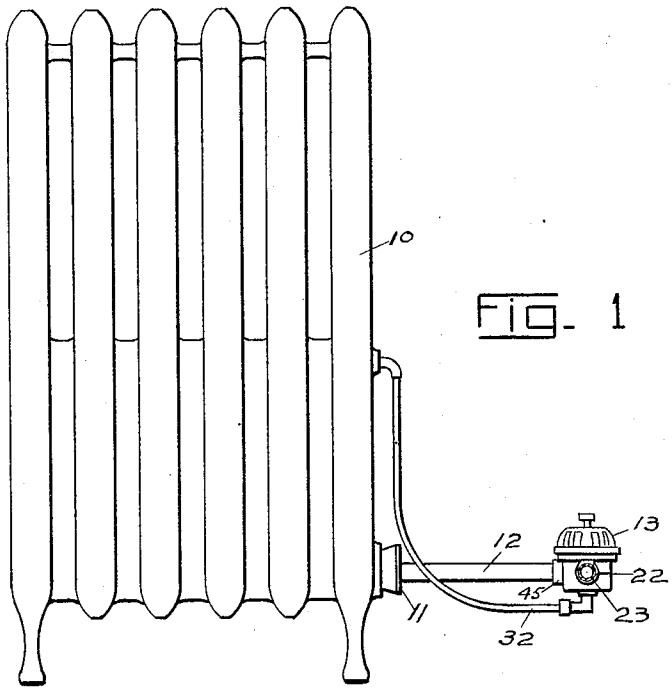


Fig. 1

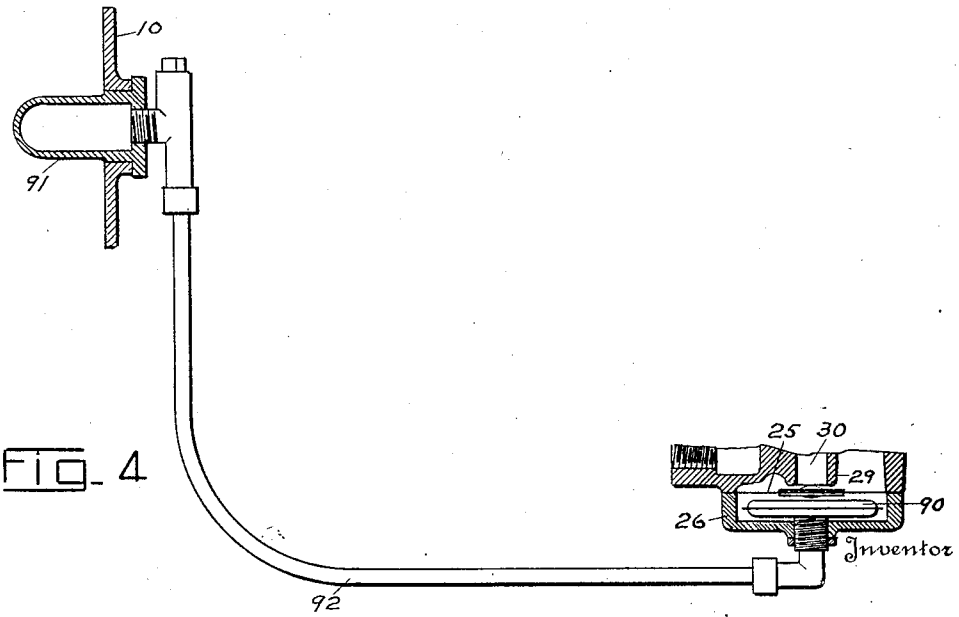


Fig. 4

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Fig. 2

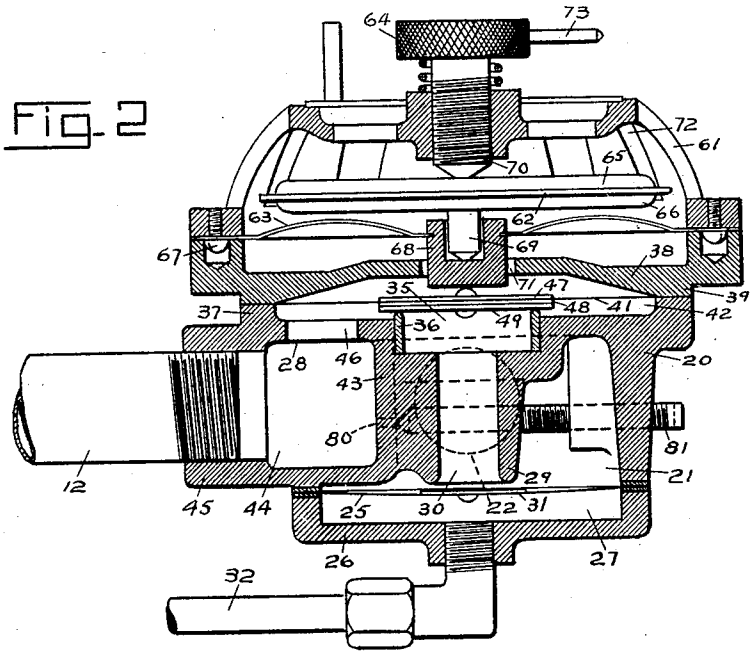
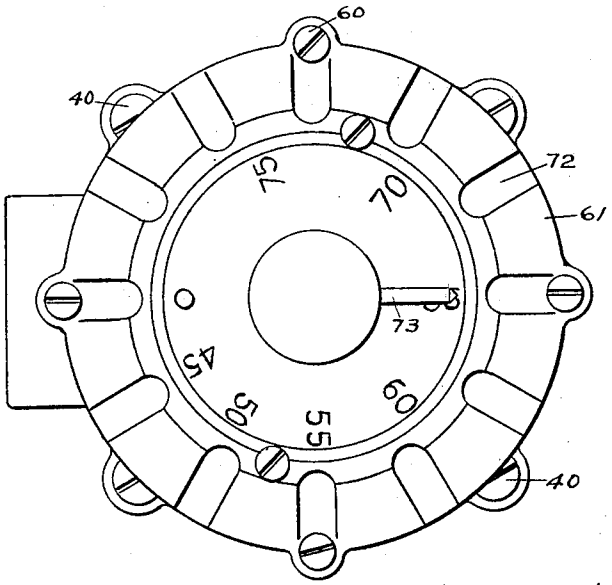


Fig. 3



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UNITED STATES PATENT OFFICE

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REGULATOR FOR GAS-HEATED STEAM RADIATORS

Application filed July 31, 1930. Serial No. 472,118.

This invention relates to gas-heated steam radiators for warming rooms, and it has to do particularly with means for regulating the amount of gas supplied to the gas burner in the radiator.

The invention employs two principles for effecting control of gas supplied to the burner: (*a*) pressure generated in the radiator by the burner, and (*b*) the temperature of the room containing the radiator. This dual control is effected by providing two valves, through both of which the gas passes on its way to the burner, with the result that closure of either valve cuts off the gas. One of these valves is controlled by pressure and the other by the temperature of the room. I also provide a by-pass whereby the burner flame is maintained, but at its minimum size, while the main flow of gas is cut off by one or the other of said valves. If desired a pilot light may be provided, in which case the by-pass may be omitted. But I prefer keeping the burner burning by means of the by-pass.

I shall now describe my invention in detail, by the aid of the accompanying drawings, in which,

Fig. 1 illustrates a gas-heated radiator equipped with my device for regulating the gas supplied to the burner which is concealed within the radiator;

Fig. 2 illustrates a vertical sectional elevation of the regulating device;

Fig. 3 illustrates a plan view of the regulator;

Fig. 4 illustrates a modification of my invention. In this view only a fragment of the radiator is shown, and only a portion of the regulator. It is to be understood that the portions of the regulator not shown are the same as the corresponding portions of the regulator shown in Figs. 1 and 2.

Referring now to Fig. 1, the radiator is of the ordinary and well known type of gas-heated steam radiator. Therefore it suffices to say that the radiator contains a small quantity of water which is heated by a gas burner in the lower part of the radiator. The only portion of the burner seen is the mixer, indicated by the numeral 11. Connected to the mixer, by a short pipe 12, is the regulator, indicated generally by the numeral 13.

Referring now to Figs. 2 and 3 it will be seen that the regulator comprises a body 20, circular in plan and containing a chamber 21. At opposite sides the body is provided with sockets 22, into either one of which a pipe 23 can be screwed, which pipe is connected to the gas supply through a suitable cock, not shown. The chamber 21 is therefore constantly filled with gas at line pressure. The socket 22 not occupied by the supply pipe is closed with a plug 24, unless a pilot light is provided, in which case it can be fed from a pipe screwed in this socket.

The bottom of the chamber 21 is a thin metal diaphragm 25, below which is a cap 26. Between the crown of this cap and the diaphragm a chamber or space 27 is formed, concerning which more will be presently said. Although the diaphragm is supposed to be shown in section in Fig. 2, it is represented by a single line, because an attempt to use two lines with the space between them hatched would unavoidably misrepresent and exaggerate the thickness of the metal composing the diaphragm.

The top of the chamber 21, indicated at 28, is preferably flat, and extending downward from this top is a circular boss 29, which boss is traversed vertically by a passage 30. For convenience I shall refer to this boss together with the passage 30, as a tube. The lower end of this tube is but a short distance from the diaphragm, so that the diaphragm can be pressed against the end of the tube and prevent the flow of gas from the chamber 21 into the tube. In a word, the tube and diaphragm constitute a valve, of which the end of the tube is the seat. Preferably, a leather disc 31 is secured to the center of the diaphragm for the purpose of insuring a more perfect closure of the valve than could be effected by the bare diaphragm engaging the seat. Gas flowing through the tube is conducted to the burner in the radiator, as will be explained presently.

The chamber 27 is connected to the interior of the radiator by a tube 32. Thus a pressure is maintained in the chamber 27 equal

to the steam pressure in the radiator. Normally the diaphragm 25 is away from its seat (the end of the tube) a sufficient distance to allow a free flow of gas into the tube. When the pressure in the chamber 27 attains a sufficient magnitude it flexes the diaphragm and presses it to its seat, thereby stopping the flow of gas through the tube. Preferably the diaphragm is slightly dished, as is the bottom of a machine-oil can, so it will snap to one position or the other. Like the oil can bottom the diaphragm requires pressure to snap it one way, i. e., toward the tube, but it snaps itself back when the pressure is sufficiently relaxed. It is not essential, however, that the diaphragm be dished, as it may be left flat, in which case the flow of gas through the tube will diminish as the diaphragm is gradually moved toward its seat, and increase gradually as the pressure in the radiator falls.

I shall now describe the remainder of the passage for gas to the burner, which includes a valve controlled by the temperature of the room containing the heater.

The tube, i. e., the passage 30, leads to a circular chamber 35 formed in the top 28, in which chamber a ring 36 is fixed, extending a short distance above the top 28. A low circular wall 37 rises from the perimeter of the top 28, and resting on this wall is a circular plate 38, which has a low flange 39 depending from its perimeter. This plate is secured to the wall 37 by screws 40, and clamped between the wall 37 and flange 39 is a flexible diaphragm 41, thus forming a chamber 42, of which the top of the body is the bottom and the diaphragm 41 the top. A partition 43 near one side of the chamber 21 forms a chamber 44. This chamber is tapped by a socket 45 extending from the body 20, into which socket the pipe 12 is screwed. See Fig. 1. The chamber 44 is connected to the chamber 42 by a port 46.

The diaphragm 41 in conjunction with the ring 36 constitutes a valve, which, when open, allows a free flow of gas from the passage 30, through the chambers 35 and 42, the port 46, chamber 44 and pipe 12 to the burner. At its center the diaphragm 41 carries two metal discs, one on each side of the diaphragm, indicated at 47 and 48, and below the disc 48 there is a leather disc 49, which is the member that actually cooperates with the edge of the ring 36 to stop the flow of gas to the burner. The diaphragm 41 is preferably, though not necessarily, made of soft leather, and the reason for providing the leather disc 49 is that in case its frequent seating on the ring 36 should wear a hole in the leather it would not allow the escape of gas into the room, as would be the case if the diaphragm itself were brought into contact with the ring or valve seat 36.

I shall now describe the thermally actuated mechanism. Secured to the plate 38 by screws 60 is a cover or housing 61, within which the thermally actuated element 62 is mounted between a spring 63 and the point of an adjusting screw 64. The element 62 is of the well known thermo-bellows-diaphragm type, and comprises two circular thin metal discs, 65 and 66, each of which is depressed, so that when they are united face to face with their edges in contact, and soldered together, they form a comparatively thin closed chamber. This vapor expands under the action of heat, pressing the discs 65 and 66 apart, more or less, bellows-fashion, thereby varying the thickness of the element in the manner well known and understood in devices of this type.

The spring 63 is made of a strip of sheet metal, its ends being secured to the under edge of the housing 61 by screws 67, the heads of which screws extend into holes in the plate 38, thereby serving as dowels. At its center the spring carries a boss 68 having a socket which receives a stud 69 extending downward from the disc 66. The tension of the spring is upward, thereby lifting the thermal element and pressing it against the end of the adjusting screw 64. The disc 65 has a conical depression in its center, which the point 70 of the screw enters. Therefore, the thermal element is supported between the spring 63 and point 70. The boss 68 extends downward from the spring a sufficient distance to pass through a hole 71 in the plate 38 and bears on the head of the rivet by which the discs 47 and 48 are secured to the diaphragm 41. Assuming that the screw 64 has been properly adjusted, it is obvious that as the thermal element 62 expands the diaphragm 41 will be pressed toward the seat (ring 36) more or less, according to the temperature of the atmosphere surrounding the thermal element, and even press the leather disc 49 to the seat 36 if the expansion of the thermal element is great enough, thus closing the valve entirely. The housing 61 is provided with numerous openings 72 to permit free circulation of air around the thermal element, thereby effecting great sensibility to temperature changes. The screw 64 carries a laterally extending finger 73, and on the top of the housing is a series of numerals representing temperatures. If it is desired to have the thermal element cut off the gas when the room temperature reaches 70°, for example, the screw 64 is turned to a position where the finger 73 points to 70 on the dial.

As the gas must pass through both valves, that is, the pressure controlled valve and the thermally controlled valve, it is plain that closure of either valve cuts off the flow of gas to the burner. In order to keep the burner lit I provide a by-pass between the chambers 21 and 44, in the form of a small port 80 in the wall 43 which separates the

chambers. By means of a needle-point screw 81 the flow of gas through this port can be more or less restricted. Preferably, the flow of gas through this by-pass is reduced to the smallest amount that will keep the burner lit while the main supply is cut off.

While the operation of my system is fairly obvious, I shall now explain a few points which may not be altogether apparent. While gravity tends to cause the diaphragm 41 to lie on the seat 36, this is prevented by the pressure of the gas in the chamber 35. It will be remembered that the chamber 21 is constantly filled with gas at line pressure. When the lower valve (25—29) is open the gas pressure in the chamber 35 is equal to the pressure in chamber 21. The chamber 35 is made large in diameter so the gas pressure in this chamber can lift the diaphragm. Furthermore, some of the gas which enters the chamber 44 through the by-pass backs up into the chamber 42, through the port 46, and notwithstanding the pressure in chamber 42 resulting from this cause is small, it is made effective by the large area of diaphragm upon which it acts, and assists in lifting the diaphragm. When the lower valve is closed it is immaterial if the diaphragm 41 does lie on its seat.

Assuming that the gas supply pipe is of ample size the gas pressure in the chamber 21 will remain the same whether the main valves are closed or open. Therefore, the flow of gas through the by-pass is always the same, and the flame supported by the by-pass may be very small without danger of its becoming extinguished. The only thing which might interfere with this is variation in the line pressure. If the line pressure varies a pressure regulator may be inserted in the supply pipe. Pressure regulators being well known and in common use it is not necessary to illustrate or describe one.

I shall now describe the modification which is illustrated in Fig. 4 of the drawings. The only difference between the structure already described and this modified structure is in the manner of operating the pressure controlled valve. In the modified structure the cap 26 is made sufficiently roomy to accommodate a bellows diaphragm 90, the lower disc of which is supported by the cap 26. Instead of connecting a pipe to the radiator, so steam from the radiator can enter the pipe, as in Fig. 1, I place a small closed vessel 91 in the radiator where it is subject to the heat of the interior of the radiator. This vessel is connected by a pipe 92 to the bellows diaphragm 90, and the vessel, pipe and bellows diaphragm are filled with a liquid which will boil at the temperature at which it is desired that the pressure valve 25—29 shall close. The bellows diaphragm 90 is so placed that when it expands as a result of the liquid in the vessel 91 boiling, the upper disc of the bellows will raise the diaphragm 25 and close the valve. While different liquids may be used, according to their several boiling temperatures, water is satisfactory. The temperature at which water boils is very close to that which would obtain in the radiator at the pressure usually carried in gas-heated radiators; that is, about one pound to the square inch. The difference in the temperature of the radiator would not exceed one or two degrees Fahrenheit.

This system has one disadvantage, in that it is less sensitive and therefore slower to act than the system employing direct steam pressure. On the other hand it has an advantage over the steam pressure system, in that the vessel 91 can be so placed that it would act even if for some reason the radiator went dry, as the heat from the burner would boil the water in the vessel 91 as well as heat from the steam. In fact, both are good. It is to be noted that both systems employ pressure created in the radiator, although one operates directly while the other operates indirectly. That both systems obtain substantially the same result is due to the fact that the heat in the radiator will always be proportional to the steam pressure.

It is to be noted that in the present application I make no claim to the thermally controlled valve per se, for the reason that it is claimed in my co-pending application, Serial No. 385,138.

While I have illustrated and described what at the present time I regard as the preferred embodiment of my invention, it is not to be supposed that I limit myself to the specific structure shown, as various structural modifications are possible without departing from the spirit of my invention and while remaining within the scope of the appended claims.

What I claim is as follows:

1. In a regulator for a gas-heated steam radiator, a pipe to carry gas to the radiator burner, a gas-supply pipe, two valves, one of which is controlled by pressure in the radiator due to combustion of gas that has traversed said burner pipe, and the other by the temperature of the air in the room containing the radiator, either of said valves being adapted to cut the gas off or reduce its flow from said supply pipe to the burner pipe, and a by-pass whereby a limited quantity of gas is passed from the supply pipe to the burner pipe, independent of said valves.

2. In a regulator for a gas-heated steam radiator, a pipe to carry gas from said regulator to the radiator burner, a gas-supply pipe, two valves, one of which is controlled by pressure in the radiator due to combustion of gas that has traversed said burner pipe, and the other by the temperature of the air in the room containing the radiator, said valves being in series, thereby enabling either of

them to cut the gas off from the burner pipe, and a by-pass whereby a limited quantity of gas is passed from the supply pipe to the burner pipe, independent of said valves.

3. In a regulator for a gas-heated steam radiator, a body adapted to connect the heater to the gas supply pipe, said body containing a chamber which is in constant connection with the gas supply, one wall of the chamber being a flexible diaphragm, carrying a valve at the center of its inside, a cap covering the outside of the diaphragm, the space between the cap and diaphragm being connected by a pipe to the steam-containing part of the radiator, a tube passing through the opposite wall of said chamber, the inner end of the tube serving as a seat for said valve, said valve being adapted to cut off the flow of gas into said tube when pressed to its seat by the pressure of the steam in the radiator; a second chamber formed in said body, which is connected to the heater burner, said chamber being connected to said tube through a valve regulated by the temperature of the room containing the heater, and a by-pass whereby a limited quantity of gas is passed from the first to the second chamber.

4. In a fuel regulator for a gas-heated steam radiator, a chamber which is constantly filled with gas at line pressure, a passage leading to the radiator burner, two valves through which gas flows from said chamber to said passage, one of which valves is controlled by the pressure in the radiator due to combustion of gas that has traversed said burner pipe, and the other by the temperature of the room containing the radiator, said valves being in series, thereby enabling either of them to control said flow of gas; and a by-pass independent of said valves which allows gas to flow from said chamber to said passage.

5. In combination with a gas-heated steam radiator, means for supplying and regulating the flow of gas thereto, comprising a pipe connected to the radiator burner, a chamber constantly filled with gas at line pressure, said pipe and chamber being connected through two valves, the flow of gas through one of said valves being controlled by the pressure in said radiator due to combustion of gas that has traversed said burner pipe, the flow of gas through the other of said valves being controlled by the temperature of the air in the room containing the radiator, and by-pass for conducting gas from said chamber directly to said pipe, the flow of gas therethrough being the same whether said valves are open or closed.

6. In combination with a gas-heated steam radiator, means for supplying and regulating the flow of gas to the burner thereof, comprising a pipe connected to the radiator burner, a chamber constantly filled with gas at line pressure, said pipe and chamber being connected by two valves, the flow of gas through one of the valves being controlled by the pressure in the radiator due to combustion of gas that has traversed said burner pipe, the flow of gas through the other valve being controlled by the temperature of the air in the room containing the radiator, and a single by-pass for conducting gas from said chamber to said burner pipe, said by-pass having a valve for limiting the amount of gas by-passed.

7. In a regulator for a gas-heated steam radiator, a pipe to carry gas to the burner, a chamber constantly filled with gas at line pressure, said pipe and chamber being connected by two valves, the flow of gas through one of said valves being controlled by pressure generated in the radiator, the flow of gas through the other valve being controlled by the temperature of the air in the room containing the radiator, said valves being in series.

8. In a regulator for a gas-heated steam radiator, a pipe to carry gas to the burner, a gas supply pipe, said pipes being connected by two valves, the flow of gas through one of said valves being controlled by pressure generated in the radiator, the flow of gas through the other valve being controlled by the temperature of the air in the room containing the radiator, said valves being in series.

9. In combination with a gas-heated steam radiator, a valve for controlling the supply of gas to the burner, comprising a body containing a chamber constantly connected to a gas supply, one wall of the chamber being a flexible diaphragm, a tube passing through the opposite wall of said chamber and connected to the burner, the inner end of the tube being close to the diaphragm, enabling the latter to be pressed against the tube, thereby stopping the flow of gas through the tube; a closed receptacle in the radiator, said receptacle being connected by a tube to a bellows-diaphragm mounted in contiguity to the outside of the aforesaid diaphragm, said receptacle, tube and bellows-diaphragm being filled with a liquid adapted to vaporize at a predetermined temperature, thereby expanding the bellows-diaphragm and pressing the first mentioned diaphragm toward the tube.

10. In combination with a gas-heated steam radiator, a valve for controlling the supply of gas to the burner, comprising a body containing a chamber constantly connected to a gas supply, one wall of the chamber being a flexible metal diaphragm, a tube passing through the opposite wall of said chamber and connected to the burner, the inner end of the tube being close to the diaphragm, enabling the latter to be pressed against the tube, thereby stopping the flow of gas through the tube, the diaphragm being

slightly dished so when it is pressed a certain distance it will snap to or fro, according to which way it is pressed, the gas pressure in the chamber being adapted to snap it away from the tube when there is no pressure on the outside; a closed receptacle in the radiator, connected by a tube to a bellows-diaphragm mounted in contiguity to the outside of the dished diaphragm, said receptacle, tube and bellows-diaphragm being filled with a liquid adapted to vaporize a predetermined temperature, thereby expanding the bellows-diaphragm and snapping it toward the tube.

11. In combination with a gas-heated steam radiator, a valve for controlling the supply of gas to the burner, comprising a a body containing a chamber connected to a gas supply, one wall of the chamber being a flexible diaphragm, a tube passing through the opposite wall of said chamber and connected to the burner, the inner end of the tube being close to the diaphragm, enabling the latter to be pressed against the tube, thereby stopping the flow of gas through the tube; a closed receptacle in the radiator, said receptacle being connected by a tube to a bellows-diaphragm mounted in contiguity to the outside of the aforesaid diaphragm, said receptacle, tube and bellows-diaphragm being filled with a liquid adapted to vaporize at a predetermined temperature, thereby expanding the bellows-diaphragm and pressing the first mentioned diaphragm toward the tube, and a by-pass for conducting a limited quantity of gas from said chamber to the burner.

12. In a regulator for a gas-heated steam radiator, a pipe to carry gas to the burner, a gas supply pipe, said pipes being connected by two valves, the flow of gas through one of said valves being controlled by pressure generated in the radiator, the flow of gas through the outer valve being controlled by the temperature of the air in the room containing the radiator, said valves being in series, and a by-pass connecting said gas supply pipe and burner pipe.

13. In combination with a gas-heated steam radiator, means for controlling the supply of gas to the burner, comprising a body containing a chamber constantly connected to a gas supply, one wall of the chamber being a flexible diaphragm, a tube passing through the opposite wall of said chamber, said tube being connected to the burner through a valve controlled by the temperature of the room containing the radiator, the inner end of said tube being close to the diaphragm, enabling the diaphragm to be pressed against the tube, thereby stopping the flow of gas through the tube; and means controlled by pressure generated is the radiator for pressing the diaphragm toward the end of the tube when said pressure attains a predetermined amount.

14. In combination with a gas-heated steam radiator, means for controlling the supply of gas to the burner, comprising a body containing a chamber constantly connected to a gas supply, one wall of the chamber being a flexible diaphragm, a tube passing through the opposite wall of said chamber, said tube being connected to the burner through a valve controlled by the temperature of the room containing the radiator, the inner end of said tube being close to the diaphragm, enabling the diaphragm to be pressed against the tube, thereby stopping the flow of gas through the tube; and means controlled by pressure generated in the radiator for pressing the diaphragm toward the end of the tube when said pressure attains a predetermined amount, and a single by-pass for conducting a limited supply of gas from said chamber to the burner.

15. In combination with a gas-heated steam radiator, means for controlling the supply of gas to the burner, comprising a body containing a chamber constantly connected to a gas supply, one wall of the chamber being a flexible diaphragm, a tube passing through the opposite wall of said chamber, said tube being connected to the burner through a valve controlled by the temperature of the room containing the radiator, the inner end of said tube being close to the diaphragm, enabling the diaphragm to be pressed against the tube, thereby stopping the flow of gas through the tube, and a cap covering the outside of the diaphragm, the space between the cap and the diaphragm being connected by a pipe to the interior of the radiator, enabling steam pressure in the radiator to act on the diaphragm and press the end of the tube when the pressure attains a predetermined amount.

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